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(54) Physical exercise apparatus.

(57) Physical exercise apparatus comprising target members (10) to be actuated by a player (20), switch means (12) associated with the target members such that activation of the target members causes a change in the status of the switch means, signal means (11) selectively responsive to the status of said switch means, and control means (40) for selectively causing said signal means to change between a first condition and a second condition.

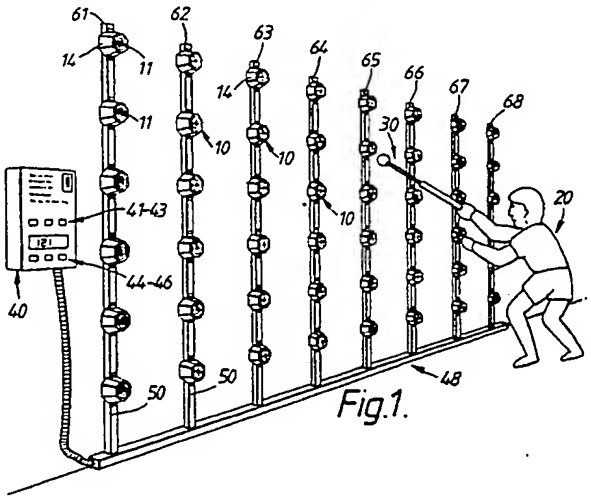

Fig.1.

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PHYSICAL EXERCISE APPARATUS

This invention relates to physical exercise apparatus.

Various forms of exercise apparatus are known, but these mainly involve physical exertion without any entertainment value for the user, or any means of competition against a standard, or any positive indication of the results in the sense of the apparatus itself providing an output of the result achieved.

It is an object of the present invention to provide physical exercise apparatus which enables the user to simultaneously experience physical exertion which is afforded by exercise apparatus as such, with the enjoyment of a competitive sport as experienced by players of racket games.

According to one aspect of the present invention there is provided physical exercise apparatus comprising a plurality of target members for arrangement at discrete spaced locations in an array for use in physical exercise by a user equipped with a playing member; each target member being actuable in response to contact therewith by a playing member; signal means associated with each target member for indicating a first condition and a second condition thereof; control apparatus for selectively causing said signal means to be switchable from said first condition to said second condition; switch means associated with each target member and responsive to said contact by the playing member with the target member to change status, said change of switch means status permitting said signal means to change from one to the other of said first and second conditions; the control means being operable to cause said signal means to change.

In an embodiment a change of status of said switch means automatically changes the respective signal means from one to the other of said first and second conditions.

Alternatively, in another embodiment a change of status of said switch means permits the respective signal means to change from one to the other of said first and second conditions subject to the status of a control input controlled by said control means.

In this embodiment when said control means prevents a change in said signal means condition the control means provides a signal indicating the change in status of said switch means.

The array may be determined by supports for the target members.

The supports may be arranged in a plurality of spaced upright columns, and a series of said target members are located in each column with a spacing therebetween. The supports may also provide conduit means for cabling to the control apparatus.

A said target member may comprise a housing accommodating its signal means and arranged to actuate its switch means. The signal means may be a lamp means which is illuminated in said second condition. Alternatively (or additionally), the signal means may emit an audible signal when in said second condition. Various visual and audible means may be used and a combination of both may prove attractive to some users.

The switch means may be responsive to displacement of the housing of the target member on impact thereof by a user equipped with a playing member thereby to return said signal means to said first condition. The expression "impact" or "strike" is intended to include a light touch since part of the housing may be formed from a material which may damage if impacted with a heavy blow. For example, the contact face of the housing may itself be a displaceable cover face (e.g. made of glass) of the lamp signal means. It may be a housing formed of plastics material which when displaced actuates a microswitch and which covers a lamp which itself is not displaced. In such a case, it will be of a material or construction which enables the lamp condition to be visible i.e. either wholly or partly formed of a material which transmits light or formed with apertures or the like to permit the lamp condition to be viewed.

The control apparatus may include an energising circuit which is connected to the signal means of each of said target members. The control apparatus may include a switching circuit coupled to the signal means of each target member and operable to switch in sequence individual target members or groups of target members from said first condition to said second condition in accordance with a game selection.

This switching circuit may be arranged to switch the target members in sequence, and after switching one target member or a group of target members and before switching another target member or group of target members, may await a signal indicative of a return of signal means associated with said one target member or group of target members to its or their first condition in respect of impact thereof by the user.

Alternatively, the switching circuit may be arranged to operate to continue the switching sequence after a predetermined interval whether or not the user has impacted said one or group of target members. In this event the control apparatus may also act to return the signal means associated with said one target member to its first condition. For example, the energising circuit may be adapted to energise the signal means for such predeter-

mined interval on each occasion it is energised in respect of the switching circuit of the control apparatus. The control apparatus may include means for generating a random sequence for the said selective switching of the signal means.

The control apparatus may include user responsive means for setting variable parameters for the use of the physical exercise apparatus: these may include the choice or selection of the "game" to be played and the choice of the "skill level" from a finite number of choices.

The skill parameters may include user selectable switching intervals. These parameters may also include user selectable durations of play.

The control apparatus may include timing means determining the duration of a user session on the apparatus. The control apparatus may include counting means for recording the number of user initiated changes in the instant condition of the switch means.

The control apparatus may include a visual display providing a display of counts related to the totalled user initiated changes. This may be in the form of a "count" or "score": the value given to each "impact" or "strike" (i.e. user initiated change) may be assigned by the game rules e.g. 10 points per impact. Likewise the game may have provision for penalty deductions from the "score" displayed e.g. for not attaining a target performance.

Different modes of operation of the control apparatus are possible in accordance with game programs. The control unit may include a microprocessor unit and the game programs may be stored in memory. In one mode the user is given an indefinite period to impact a target member in its second condition. In another mode, the user has to impact the target members within a predetermined time interval.

An embodiment of the invention will now be described by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 shows schematically and in perspective view physical exercise apparatus according to an embodiment together with an illustration of a player/user;

Figure 2 shows an enlarged view of a target member of the apparatus of Figure 1;

Figure 3 shows an embodiment of a playing member for use by a user with the apparatus of Figure 1; and

Figure 4A is a block diagram of the control unit of the apparatus;

Figure 4B is a circuit diagram of the main central processor logic board of the control unit;

Figures 4CA and 4CB show circuitry for the game input and the score display;

Figure 4D shows the mechanics and wiring for the lamps;

Figure 4E shows part of the lamp drive circuit;

Figure 4F shows an interrupt circuit to produce interrupt signals from the lamps to the central processor unit;

Figure 4G shows the lamp driver interface circuitry; and

Figure 4H shows the sound processor circuitry.

In this embodiment of physical exercise apparatus, target members 10 are arranged at discrete spaced locations in an array 48 of target members 10 for use in physical exercise apparatus by a player/user 20 equipped with a playing member 30. The playing member 30 is a racket with a handle portion 31, shaft 32 and head 33 made for example of sponge rubber material for striking the target members.

Each target member 10 is actuable in response to contact therewith by a playing member. Signal means 11 (wholly inside a housing 14 of the target member 10 which transmits light) are associated with each target member for indicating a first condition and a second condition thereof. Each signal means of this embodiment comprises lamps (see Fig. 4D) which indicate the instant condition thereof. In the first condition the lamps are OFF and in the second condition the lamps are ON.

Control apparatus 40 (including a computer programmable unit and a memory for storing game programs) selectively causes the signal means 11 to be switched from the first condition to the second condition.

Switch means 12 (Fig. 4D) is associated with each target member 10. The switch means 12 is coupled to the signal means 11. The housing 14 is displaceable in response to an impact thereon by the user's playing member 30. In consequence, the switch means 12 is responsive to said contact by the user's playing member 30 with the target member 10 to change status. This change of switch means status permits the signal means 11 to change from the second to the first condition subject to the status of a control input controlled by said control means (as will be further described with reference to Figure 4E - "cap out latch" signal).

The control apparatus is operable to cause signal means 11 to switch to the second condition in a sequence to be followed by the user in accordance with the game selection. The user follows the sequence of illumination of the target members 10 as rapidly as the user is able, tapping in sequence the illuminated target members and as one associated signal means 11 switches back to the first condition (OFF) another changes to the second condition (ON) presenting a continuous challenge

to the user for the duration of the exercise session.

In this embodiment, the array is determined by supports 50 for the target members 10. These supports 50 are arranged in eight spaced upright columns 61 to 68 each having six target members 10 located therein with a spacing between each target member 10 in a column. In this embodiment, the supports 50 also provide conduit means for cabling to the control apparatus 40. The cabling provides the means of energising the signal means 11 and control lines for the switch means 12.

As shown in Figure 2, the target means 10 comprises a housing 14 accommodating its signal means 11. The switch means 12 (Fig. 4D) is actuable by the housing 14.

The control apparatus 40 includes an energising circuit which is connected to the signal means 11 of each of the target members 10 via the aforementioned cabling means. The control apparatus 40 also includes a switching circuit individually coupled by cabling means to the signal means 12 of each target member 10 and operable to switch in sequence individual target members or groups of target members 10 from the first condition to the second condition in accordance with a game selection, games being stored in a memory associated with a programmable unit in the control apparatus.

The control apparatus 40 includes means for generating a random sequence for the selective switching of the signal means 11. Each target member 10 in the array may be allocated a number (e.g. 1 to 48) and the generating means may include a number generator generating the numbers 1 to 48 which is then used as address data for the output of the energising circuit. The control apparatus 40 includes user responsive means such as buttons 41 to 43 and 44 to 46 for setting variable parameters for the use of the physical exercising apparatus e.g. "game" choice from "1,2,3" and "skill level" from "low", "medium" and "high" as will be further described with reference to Figures 4A to 4H.

Alternatively, or additionally, the user responsive means may set parameters which include user selectable switching intervals selectable by the buttons 41 to 43, for example, to select intervals between switching operations of the energising circuit of 5 seconds, 8 seconds and 10 seconds respectively. Another set of parameters includes user selectable durations of play, for example, 5 minutes, 10 minutes, 15 minutes.

Alternatively, the control apparatus 40 may include timing means determining the duration of a user session on the apparatus.

The control apparatus 40 includes counting means (not shown) for recording the number of user initiated changes in the instant condition of the switch means 12. This count may be displayed on a visual display 47 providing a visual display of the counts related to the totalled user initiated changes. Depending on the electronic circuitry, the count display may be a running total which changes progressively during the user session or a final total displayed at the end of the session.

It will be appreciated by those skilled in the art that many modifications to the apparatus described in Figure 1 are possible.

Concerning the array 48, it would be possible to mount the target members 10 on supports 50 which extend in each column and have apertures for the cabling to enter housings 14 of each of the target members 10. Alternatively, the supports 50 can be in sections of tubing which only extend between housings 14, these housings being adapted at 15,16 to mechanically link with the conduit support 50. Either such array would have fixed locations for the target members 10. In the Figure 1 embodiment, it is envisaged that each column would be 8 feet in height and that the columns would be spaced apart by 2 feet intervals.

Alternative provision for the array could be provided by a backing panel with a series of connection points thereon. The target members and connection points could be adapted to link together mechanically. Suitable devices could be provided for making electrical connections between electrical carrier means on the panel and the signal means 12 within the target members 10. Such an arrangement could facilitate the user making changes in the position of the target means according to the height and reach of the user.

Although it would increase the cost of production, each target member may be mounted on an individual track and may be displaceable by a motor associated therewith. Control of the motor operation could be another function of the control apparatus 40 which may contain memory means and a microprocessor unit under program control. This system could have the facility for the user to input data relating to parameters such as height and reach, whereby the target means would then be spaced for optimum use by that user.

The control apparatus 40 may include a microprocessor to generate the switching sequence for the signal means 12. The microprocessor may also control the operation of the exercising apparatus in terms of the selectable parameters and an interactive element can be introduced. For example, the user may be asked to input relevant data (e.g. height, weight, previous performance) from which the microprocessor will determine such parameters as the intervals between switching of the signal means 11 by the control apparatus 40. The microprocessor may be used to select different exercise routines (games) and different illumination patterns. For example, instead of the signal means 11 being

actuated in a totally random sequence the microprocessor may ensure, for example, that successively switched signal means 11 are in different columns or at a different height (or both).

The playing member or racket design is intended to ensure that the user strikes the target means 10 with just a touch - where the word impact or strike is used it is not intended that a significant force is required. In an alternative embodiment, the signal means may be an illuminated actuable lamp, e.g. of the kind found on pin-ball machines, which both illuminates and is displaceable to actuate a switch means. In the described embodiment of Figure 1 (where electrical connections are made by cabling) the switch means 12 is a microswitch as mentioned below.

Instead of cabling, which in the Figure 1 embodiment requires two leads to each target member from the energising circuit of the control apparatus to carry the electrical power and two leads to each signal means from the switching circuit of the control apparatus to carry the switching signals to the microswitches, computer technology could be introduced in the form of bus boards to carry digitised signals to intelligent means at each signal means.

In describing the apparatus of Figure 1 reference was made to control circuitry 40. With reference to Figures 4A to 4H a description will now be given of a control unit and related circuitry.

Referring to Figure 4A, the control unit comprises a user interactive input 100 which is used to set the level of game skill required and select the game to be played. The input from this unit goes to the microprocessor control unit 200. The user interactive input unit 100 may be in the form of a keyboard and may also have an LCD or LED display to indicate the choices which the user may make. In particular, the input unit 100 will have select switches for the user to select from a choice of games and from a choice of skill levels. The microprocessor control unit 200 performs all the digital logic functions necessary to operate and make the game function. The unit 200 supervises all aspects of the apparatus. It controls both the input e.g. switches, and output e.g. sound/lamp/scoring/printer. In this embodiment, the microprocessor control unit is based on the 8052AH basic chip manufactured by the Intel Corporation of USA. It is in the MCS-51 range of microcontroller chips. The Intel publication for this component is referenced under the number 270015-001.

The control unit 200 is interfaced with a sound processor circuit 300 with its loudspeaker 301, a score display circuit including an LED display 400 and a lamp driver interface circuit 500.

The interface circuit 500 is to enable the control unit to drive the lamps of the apparatus shown in Figure 1. The power required for the lamps determines that a power interface is required. Power transistors/relays/triacs may be used for the energisation of the tungsten filament lamps. In this case it would be necessary to isolate the lamp driver interface circuit 500 from the computer logic circuits. This is achieved through opto-isolation techniques. In an embodiment the lamps are operated on 24 volts and have a power rating of 21 watts.

The control unit 200 will now be described with reference to Figure 4B. The main components are the central processor unit 210 which is interfaced by means of an address decoder 220 with RAM memory 230 and 235 (there are two sections of RAM memory to accommodate a memory capacity of 16K) and an EPROM memory 240 which stores the game programs. In addition, there is the address latch 250 which determines whether an address or data byte value is on the CPU bus. There is a reset circuit 260 which has a mechanical reset 261 operated for example by a coin mechanism. The circuit also contains the gates 262, 263 and 264. There is also a voltage level translator 270 which interfaces between the TTL levels and the voltage levels required by an optional terminal or VDU used for programming.

The clock pulses of the CPU 210 are determined by the clock components 280. The outputs from the CPU 210 on the ports PO.0 to PO.7 are pulled up by a bank of resistors 290.

The address decoder 220 is a component 74HCT138. It receives the three-line address on lines A13 to A15 from the bus 212. It is then able to output the memory address signals Y0 to Y7 for the purposes of addressing the memory. In this embodiment, the memory 230,235 comprises two IC RAM circuits identified by the chip numbers 6264. This capacity of RAM memory enables this embodiment to be operated to input the game programs through the RAM and after checking these programs the programs may then be stored in the EPROM 240.

The address latch 250 is a component 74HCT373. This latch 250 is a decoder which operates to indicate to the memory 230,235 and 240 whether the information on the bus 212 is address information or data. The address latch is enabled on pin 11 by means of an address latch enable signal from the CPU 210 via the gate 262 which receives the output from the CPU marked ALE (address latch enable). The CPU 210 on ports P1.0 to P1.7 has on P1.7 and P1.6 outputs to the printer and the printer busy line respectively. On port P1.2 there is a "PWM" output. This output is a function of the 8052 chip and enables the CPU 210 to issue instructions regarding the pulse counting

which corresponds to "strikes" by the user of the apparatus and the rewards given for a strike. The PWM signal enables two parameters to be controlled, namely the number of pulses and the width of the pulses in a given time interval. By way of example, the game may require a reward of ten points for a "strike". It is then possible to set the PWM signal such that in a given interval there are ten pulses of 100 µs wide. The signal on the port INT1 is an interrupting signal from the microswitches of the lamp display (see Figure 4D and Figure 4F). This signal stops the operation of the CPU 210 which is required to service an interrupt routine in the program. It is then possible, for example, for the CPU 210 to poll the lamps in order to ascertain their status, for example after a "strike".

The voltage level translator 270 comprises an IC chip known as MAX232 which is manufactured by Maxim Electronics, U.S.A. This circuit component converts TTL levels of 0 to 5 volts to the voltage levels for a VDU terminal at plus or minus 12 volts. It takes the signals from the CPU 210 at its right-hand inputs and at its left-hand outputs, outputs voltage levels plus or minus 12 volts. By way of example, pin 11 may receive a pulse at 0 volts and output a signal of plus 12 volts on pin 14. The clock components 280 comprise a crystal oscillator X1 and capacitors C2,C3 which are gated with the micro to set the internal oscillator of the CPU 210 to operate at a frequency of 7.3278 MHz.

The port PO.0 to PO.7 issues both address information and data in a multiplexed fashion. There are also lines P2.0 to P2.7 which are further address lines to the bus, whereby there are sixteen address lines for the purpose of addressing the memory. The bank of resistors 290 are pull-up resistors which enable the signals on the ports PO.0 to PO.7 to operate effectively on the bus 212.

A reset mechanism 260 includes a coin operated reset 261 which is responsive to the interactive unit 100 which may contain a coin operated mechanism. Within the reset circuit 260 there is also a manual reset S1 which may be internal and may be screened for authorised use only. When the reset is made either by the mechanism 261 (responsive to the user interactive input 100) or whether an internal reset via the CPU 210, the control unit then actuates a program in the EPROM 240 which enables the user to make selections at the interactive input 100. These selections involve a choice of game: lamps will illuminate indicating to the user that the user should "select a game" and "select a skill level". In an embodiment, there will be a choice of three games and three skill levels. The program initially operated by the EPROM 240 will enable the user to make this choice.

In the reset circuit 260 there is a capacitor C4, the purpose of which is to ensure that the reset pin RST of the CPU 210 is taken to 5 volts during the reset. On release of the reset the capacitor C4 charges to hold the line up for a few milliseconds in order that the CPU can reset.

At the CPU 210 further outputs WR and RD and PSEN are signals which enable operations such as write, read and program store enable. It will be seen that these are gated appropriately by the gates 262 and 264. The combination of the RD signal and the PSEN signal to the gate 264 enable a program to be run from the EPROM 240. The signal ALE (address latch enable) via the gate 262 enables the address latch 250 to address the RAM memory 230,235 or the EPROM memory 240.

Adjacent the gates 263 there is a component 265. The component 265 indicates in dotted line a resistive link to plus 5 volts which is necessary if the EPROM 240 is an IC 2764 but not required if the EPROM 240 is an IC 27128.

The game input and scoring circuits of Figures 4CA and 4CB will now be described. The interactive input unit 100 comprises the game select switches 110 and the skill select switches 112 which are user operable switches. Game select switches 110 offer a choice of three games and the user actuates the appropriate switch. The signals from these switches are connected to a games driver 120. Likewise, the skill select switches 112 enable the user to actuate a switch to select between a skill level of low, medium or high, and these signals are sent to a skill driver 122. The drivers 120,122 are IC components 74HCT175 and are flip-flops. It will be noted that resistors are connected to pull up the input signals. The output signals D1 to D6 are led back to the CPU 210 of Figure 4B to indicate to the CPU 210 the game and skill choices made by the user. Further outputs from the games driver 120 and the skill driver 122 are input to a lamp driver 124 and together they ensure that there is only one output possible for the choice of game and choice of skill level. The output driver 124 is an IC chip ULN 2803A manufactured by Sprague, and a power buffer for the lamp array 126. It is employed here to control lamps in the indicator lamp array 126. The array 126 has a lamp for each of the games 1,2,3 and each of the skill levels H,M,L (high, medium and low). There is also a "GO" lamp which indicates that the user has pressed the "GO" button to initiate game play.

The "GO" button 128 is actuated by the user after setting the game and skill level switches. Until the "GO" button 128 is depressed, the user can alter his choices. It will be noted that the "GO" switch toggles between a normally closed and normally open position. It sends a signal to a play latch 130 which also receives an input from a reset

"GO" flag from the CPU 210 (Figure 4B). The play latch 130 is employed to latch the lamp driver 124 to indicate that the "GO" condition has been initiated. In addition, the play latch 130 sends a signal to gate 132 from which a further signal is sent to a reset gate 136 which sends an output to reset the score counter. In addition, the play latch 130 sets the "GO flag" at the CPU 210. In the CPU 210 the "GO flag" signal causes the CPU unit 210 to read the signals D1 to D3 and ascertain which game has been selected and to read the signals D4 to D6 and ascertain which skill level has been selected. The gate 136 keeps the score counter reset during user selection (i.e. during the period when the user is selecting his choice of game and his choice of skill level). The user only presses the GO switch 128 after finalising his selection. There is a further reset mechanism 142 which is actuated by a coin operated mechanism associated with the control unit. It is envisaged that users/players will pay for the games through a coin mechanism.

The gate 134 is employed to ensure that the reset gate 136 can output a signal to the counter to reset it when the CPU 210 inputs a signal indicating that the player should select a game. This supposes that the player may have ended a game and may be in credit to play another game. A signal from the CPU 210 "select game" then passes through the gate 134 to the reset gate 136. This signal also passes to the transistor 138 and the indicator 140. The indicator 140 has a lamp for each of the selections "game" and "skill" and these lamps illuminate when the player is required to select by actuation of the switches 110 and 112 the game and skill levels required.

In Figure 4CB the circuit for the LEDs display of the player's score is schematically illustrated. The LED display 400 is driven by a display driver 410 which is an IC chip ZN1040E manufactured by Ferranti. This is an up/down counter chip which enables the CPU 210 to instruct the counter to "add" points or "deduct" points according to the game program. The output signals of the display driver 410 to LED displays 430 pass via a bank of resistors 412. The resistors 412 are current limiting 75 ohm resistors. These lines carry the logic information to the LEDs indicating the numerical value to be displayed. The power for the LEDs 430 is fed from the display driver 410 via transistors 420 which control the power supply to the LEDs 430. At the input to the display driver 410 there is an input on a line PL.2 DB13 which is taken from the CPU 210 of Figure 4B. This signal is the "PWM" signal which, as discussed above, can be controlled to vary the parameters of pulse number and pulse width for the purposes of driving the LED displays. The "PWM" signal can be set so that a "strike" gives the user for example ten points or other variations which are determined by the game programs stored in the EPROM 430 of Figure 4B.

The lamp mechanics of the apparatus associated with the control unit are shown in Figure 4D for the purpose of showing the operation of the switch means 12. The switch means 12 is shown as a microswitch but it could be another type of switch, e.g. a reed switch. In the lamp 600, a housing 610 is displaceable relative to the lamp bulb and its holder 620 to actuate the switch means 12. In an earlier embodiment, the bulb itself was displaceable and associated with the microswitch. In this embodiment, the housing 610 actuates the switch means 12. The switch means 12 has lines 631,632 and 633. Line 631 carries a "normally closed" signal. Line 632 is to earth. Line 633 carries a "normally open" signal. The lamp bulbs 620 operate at 24 volts a.c. and at a power rating of 21 watts. This requires a driver circuit which will be described in part with reference to Figure 4E. It will be noted that the power supply lines 640 go to the power supply circuit of Figure 4E and that the line 633 is connected to the memory capacitor supply circuit for capacitor 660. The line 631 is used to set the status of the lamp 600 at the control circuit of Figure 4B via an interrupt circuit to be described with reference to Figure 4F.

Each lamp 600 is associated with a respective power circuit 690 to be described with reference to Figure 4E. The power circuit of Figure 4E represents one part of the lamp driver logic of Figure 4G (to be described). The lines 633 from the switch means 12 of Figure 4D are connected to an input for a power driver latch 650. One wire of each lamp is common and connected to 24 volts a.c. The other wire is connected to its own triac 670. The input to the power driver latch 650 is associated with a capacitor 660. Another input of the power driver 650 is associated with a latch 680 which is closed by a signal designated "cap out latch" signal derived from the circuit of Figure 4B as will be further described with reference to Figure 4G.

An interrupt circuit 700 will now be described with reference to Figure 4F. The interrupt circuit takes the signals on output lines 631 from each of the switch means 12 and provides an interrupt signal INT1 to the CPU 210 of Figure 4B in order that the lamps can be polled as to their status. It will be seen that there is a series of 6 interrupt gates 710 each with eight inputs for 8 lines 631. It will be readily appreciated that this corresponds to an array of 48 lamps arranged in 8 columns with 6 lamps in a column. The inputs on lines 631 arranged in groups of 8 to an interrupt gate 710 are intended to produce an output signal on line 711 whenever one of the lamps changes state due to the player striking the lamp. The interrupt gates 710 are NOR gates and the IC component is

HC4078. When the switch means 12 of Figure 4D changes state due to the lamp being struck by a player, the line 631 which usually carries the NC signal (normally closed signal) changes state to an open state. In consequence, the signal on line 631 goes up to 5 volts and the input on gate 710 goes up to 5 volts also. Output lines 711 from each of the gates 710 go to a NAND gate 720. This NAND gate 720 is an IC component 74LS30 which is operated as a latch and an inverter. When the output lines 711 go to ground, then the output 721 of the NAND gate will also change state. This output line 721 goes to a test circuit 750 with a lamp 751 that indicates the change of state of the line 721. This is especially useful for diagnostic purposes when engineers are maintaining the system. The signal on line 721 also goes to a monostable circuit 730. Monostable circuit 730 comprises an IC circuit HEF4001. This provides an input to a buffer 740 which is actually an NOR gate of the IC chip HEF4001. The buffer 740 provides the interrupt signal as an input to the CPU 210.

The lamp driver interface circuit 500 will now be described with reference to Figure 4G.

An addressable decoder 220 receives the inputs A13 to A15 which are addresses from the CPU 210. These are output as signals Y0 to Y7 as shown in Figure 4B. By way of example, the output Y3 has the value 6000H to 7FFFH. It is input to a demultiplexer 530. The demultiplexer 530 is an IC chip HCT154. It also receives signals A8 to A11 from the CPU 210. As can be seen from the drawing, its outputs Q-R to E-F are output to the pulse stretcher 840. Further outputs are designated game output latch, game input read, and sound chip enable. An addressable latch 540 comprises an IC chip HCT259. The latch 540 receives an input from gate 545. Gate 545 is an IC component HCT32. This gate receives a write signal from the CPU 210 and a signal star 16. Further inputs DO and AO, A1, A2 are data and address signals from the bus 212 of the CPU 210. The addressable latch 540 is central to the operation of the lamp driver logic circuit. Its outputs which are identified in the drawing control the operations of this circuit. Output game select goes to the interactive user input 100. The "enable matrix" signal goes to a zero cross switch which via the zero cross line 830 ensures switching of the lamps at the zero crossing point of the power supply. The output game select DB10 goes to the circuit of Figure 4CA and in particular to the transistor 138 associated with the status indicator 140. Likewise the signal reset GO flag DB9 goes to the play latch 130 in Figure 4CA. The signals "input latch", "output latch", "flash on/off" and "lamp enable" are signals which are employed in the operation of the lamp driver.

The buffer latch 550 is employed as a buffer between the CPU 210 with its signals DB1 to DB6 and the "GO" flag signal DB8 to a bus 860 which carries the output signals D0 to D7. The signals DB1 to DB6 as aforesaid represent the game selected (games 1 to 3) and the skill level selected (high, medium or low). The "GO" flag signal DB8 indicates that the user has initiated play by pressing the "GO" button 128 of Figure 4CA. It will be noted that a further input is arranged to couple a manual switch for testing the lamps. This is internal to the control unit and not accessible to the normal user.

The output signals D0 to D7 onto the bus 860 are used to address an array of driver circuits. It will be noted that there are 6 identical driver circuits each driving 8 lamps. Each driver circuit comprises a logic switch 810, gates 812 and 814 and a latch 820. In addition, they also comprise the buffer 650, capacitor 660, triac 670 and cap out latch 680 previously described with reference to Figure 4E. A power supply takes the form of a transformer unit 560 for the power supply to the lamps 610 (of Figure 4D) as already shown in Figure 4E and as also shown in this Figure. The power transformer 560 is associated with a quad opto-coupler 565. This coupler 565 passes to a Schmidt trigger 570 to clean the pulses of the power supply. The output of the Schmidt trigger 570 then proceeds to a zero cross switch 580 linked to the zero cross line 830. The zero cross line ensures (in known manner) that the lamps are switched on and off at the zero point of the 24 volt a.c. supply cycle. It is to be noted that with the lamp 610 operating at 24 volts a.c. and a power rating of 21 watts, then the peak voltage is 40 volts and it is advantageous to arrange for zero cross switching. This ensures that the life span of the lamps is maximised and it also eliminates the effects of interference which might otherwise arise at alternative switching points. The zero cross enable switch 580 is an IC component HEF4066 and is a switch which is operated under the control of signals from the CPU 210 via the addressable latch 540.

The Schmidt trigger 570 is also linked to an indicator array setter 590 which is used to provide an override signal to the entire array of lamps 610. The input to the setter 590 for the flash on/off signal is derived from the flash on/off output of the addressable latch 540. This signal is designed to flash the entire array of lamps and can be used in a program for a game, for example to initiate the game or for example as a reward for achieving a particular target.

The zero cross switch 580 which is an IC component HEF4066 is a CMOS logical switch and is addressed by the address latch 540. Similarly, the rate of flashing set by the setter 590 is adjust-

able according to the signal output from the addressable latch 540.

Turning to the lamp circuits with the logic switches 810, transparent latches 820 and the previously-mentioned buffers 650, these are arranged in units each to control 8 lamps. The logic switch 810 acts as a flip-flop in response to the CPU bus signals D0 to D7. The switch 810 is an IC component 74HCT574 which is described as an octal D-type flip-flop. It has an input via the gate 812 which couples a signal from the demultiplexer 530 and a write signal from the CPU 210. The outputs of the logic switch 810 are input to a transparent latch 820. Latch 820 is an IC chip 74HCT573. Its main purpose is to enable the CPU 210 to poll the lamp array to ascertain the current status of any of the lamps. An enable signal for the transparent latch 820 is derived from the gate 814 which receives a respective input e.g. E-F from the demultiplexer 530 and also a read signal from the CPU 210. It also receives the "cap input latch" signal from the addressable latch 540. As explained with reference to Figure 4E, the lamp circuit also comprises the buffer 650 and as already explained, this provides the control input to the triac 670. Likewise, the cap out latch 680 receives the signal "cap output latch" from the addressable latch 540.

At the input to the gate 812 prior to the logic switch 810, there is the signal WR. When signal WR is low, it puts a "true" signal to the gate. This enables the outputs of the logic switch 810 to go to "high" or "1" and charge the capacitor 660. When the player/user hits a lamp 610 and changes its state, the change is effected by means of the switch means 12 arranged in parallel across the capacitor 660 (switch means 12 being shown in the circuit of Figure 4D). The capacitor is then able to discharge and sends a signal through the buffer 650 to the triac 670. Thus, the capacitor 660 is charged in response to signals from the CPU 210 and discharged in response to the lamp being struck by a player and changing the state of the switch means 12.

In the lamp circuits the logic switches 810 are arranged in a first bank and they are effective for turning the lamps on and off in accordance with signals of the CPU 210 and of course in accordance with a program stored in the EPROM 240 (Figure 4B). The transparent latches 820 are the means by which the CPU 210 can poll the circuits to interrogate them and enquire whether the state of the lamp has been changed by a player striking the lamp to alter the condition of switch means 12. The buffers 650 are the means by which the triacs 670 are switched in response to signals from the CPU 210 and the switch means 12 respectively. If the program decides that the lamp is not to be extinguished when the user "strikes" the respective housing, this is accommodated by the "cap-out latch". By means of the "cap-out latch" being set to "low" the capacitor can be discharged without switching off the lamp. For this purpose the cap-out latch is set by a signal 10 from the addressable latch 540. Then the lamp 610 stays on after a "strike".

The triacs 670 are arranged to drive the lamps 610 at the zero cross point. The switching frequency is related to the normal power supply cycle (in UK the 50 Hz cycle).

The cap out latch 680 is actuated by the respective signal from the addressable latch 540.

The pulse stretching circuit 840 comprises an IC 74HCT541 which has a technical specification of an octal driver. It receives the CPU pulses EF to QR via the demultiplexer 530. The pulse stretcher 840 extends the duration of pulses from the demultiplexer 530 to 2.5 ms. The purpose of extending the duration of these pulses is to provide the inputs OE1 to OE6 for the series of logic switches 810. Note that each of the 6 logic switches 810 has a separate one of these inputs OE1 to OE6. The necessity of extending the pulses is in order to ensure that the pulses are long enough for the capacitors 660 to charge up, to trigger the triacs 670. In addition, the pulse stretcher 840 has an input signal "lamp enable" which again comes from the addressable latch 540.

The sound processor circuit 300 is illustrated in Figure 4H. The main component is a sound emulator 310 which comprises an IC chip AY8912 manufactured by General Instruments which receives input signals D0 to D7 via the data bus 212 from the CPU 210. It also receives a signal BCI and a signal BDIR on further logic inputs from the CPU A0 and A1 which have been gated. The gating takes place in a driver circuit 330 which is an IC chip HCTO2. A further input comes from a clock generator circuit 320 which is an IC chip 4001BE. The clock generator is set to run at a frequency of 2 MHz onto pin 15 of the sound emulator 310. The sound emulator 310 has 16 registers. The data input from the CPU 210 determines the sound emulation signals which are combined and output from the sound emulator 310. The data input signals are able to select a register within the emulator 310 and also to attach a value to that register (by means of hexadecimal signals). The signals to the driver 330 are the write signal WR from the CPU 210 and the signal *14 from the decoder 220 on the lamp driver circuit of Figure 4G. Output channels of the emulator 310 take three outputs which are strapped in order to be connected to an amplifier 340 for mixing. A control switch 390 enables the apparatus to be operated without sound if it is actuated accordingly.

The amplifier 340 is an IC chip LM386 manufactured by National Semiconductor. Its output goes to loudspeaker 350 by way of a Zobel unit 360 which prevents oscillation. This Zobel unit 360 has a 10 ohm resistor and a 0.1 capacitor. It is also associated with a volume control 370. The volume control 370 is internal to the unit and would normally be operated by the proprietor. There is also an internal tuner 380 on the input side of the amplifier 340.

The Use of the Apparatus for "Games"

Reference is made to the drawings, particularly Figures 1 and 4A.

Initially, to start a game, a metal token is entered into a type S10 coin mechanism which may form part of the user interactive input 100 (Figure 4A) on a wall mounted enclosure 40 (Figure 1). A voltage pulse from this mechanism is used in the Reset mechanism 260 (Figure 4B) to signal the CPU 210 that a game is about to start.

At the present time, one of 3 games (see Figure 4CA) is then selected at one of 3 skill levels namely low, medium or high by way of depressing front panel buttons/switches on the control box 40 (Figure 1). As the button is depressed, it lights up to indicate the selection (see array 126 in Figure 4CA). During this "input stage", the player may change his mind at any time by choosing a different game and skill level in which case the appropriate game and skill lamp in array 126 will be illuminated. Also, at this stage (and indeed at any time even during play) there is a SOUND ON/OFF button which may be toggled on/off as desired. After making a selection, the user actuates a GO switch 128 (Figure 4CA). At this stage, it is not possible to change the selected game. If a player inserts the token and for some reason, say in error, tries to select the "GO" switch 128 without first selecting a game and skill level, then the control electronics will detect this condition and wait for a valid entry to be made.

Presently all games software is written in both "Control Basic" high level computer language and machine code (where speed is important) and runs on the INTEL 8052AH type microprocessor chip (CPU 210). When the CPU 210 detects a "GO" condition, logical instructions are sent to the programmable sound processor circuit 300 (Figure 4H) to play a suitable introduction to the selected game. The low level output is amplified by an integrated circuit chip 340 and fed to two 3 Watt extension speakers 350, one at each side of the array of target members 10. Currently the volume level is prefixed internally of the control unit 40 (Figure 1) by the volume control 370 (Figure 4H). Presently the musical "INTRO" is simply a "COUNT-DOWN" type of musical introduction.

In essence, the object of all the games played with the apparatus is to keep fit and at the same time to have enjoyment in the process. The game programs stored in the memory 240 (Figure 4B) control all aspects of play. Any program may be written such that an infinite number of game sequences is possible depending on what is actually required. The four games detailed here, therefore, are only representative of the large number possible.

Game 1 - "RANDOM FIVE"

In this game the CPU 210 will light up 5 lamps 620 of Figure 4D at random, each lamp 620 being associated with a target member 10 of the array of Figure 1. These 5 lamps 620 illuminate at selected locations on the array as separate entities As the 5 lamps 620 light up, the CPU 210 instructs the sound processor circuit 300 (Figure 4H) to produce a "LAMPS-ON BLIP" for the awareness of the player. The player now has a fixed length of time to extinguish all the illuminated lamps 620 one after another with the playing member 30. The length of time available is programmable. It is directly related to "SKILL LEVEL" switches 112 of Figure 4CA on the control box 40. The "low", "medium" and "high" skill level times would be 15, 10 and 5 seconds respectively. The lamps 620 may be extinguished by contacting the housing 14 of the target member 10 with the playing member 30. This action activates the switch means 12 whose actuation is used to put the lamp 620 out (as described with reference to Figure 4D). As the player 20 hits each housing 14, an audible "HIT" instruction is sent to the sound processor circuit 300 and hence through the amplifier to the speakers 350; also a "SCORE" of say 10 points is registered on the display 400 (Figure 4CB). Failure to extinguish all the lamps 610 in the allotted time period results in the CPU 210 generating a signal to the sound processor circuit 300 to cause a low pitched "FAILURE" sound to be generated. Success in terms of the player striking all the required housings 14 in the available time gives rise to a mini "FANFARE" sound. A further sequence of 5 lamps 620 illuminated at random is then repeated with the same timing. The game length is predetermined for 5 minutes play. At the conclusion of the game, a printout of the scores may be made available to the player by means of the addition of a printer (not shown).

Game 2 - "ONE OF A KIND"

This game relies on the player exercising at his or her own pace. The CPU 210 first causes one lamp 610 selected at random to be illuminated. The player is required to strike the associated housing 14 of the respective target member 10 to record a "HIT" and to register "SCORE" as mentioned above. The "HIT" causes the associated switch means 12 to turn off the lamp 620. The CPU 210 then causes another lamp 610 to be illuminated at random. Again, this lamp 620 will remain illuminated until the player strikes the associated target member 10. By proceeding in this way over a game period of say 5 minutes, it is obvious that the faster the player moves the more lamps 620 are extinguished in the playing time. The skill level may include a provision to determine how far the illuminated lamp 620 will be apart thereby making more stretching necessary for the more experienced player. The final score reflects how fast the player has gone. Each time the game is played an improvement can be achieved up to some maximum fitness level for the particular player based on e.g. age, height, weight.

Game 3 - "RANDOM WALK"

The game starts with the CPU 210 causing a "SNAKE" of lamps 620 to illuminate so that at any time up to 5 lamps are illuminated in the array of target members 10 of Figure 1. The "SNAKE" progresses at random around the array in a snake-like fashion. The player proceeds by extinguishing any part of the snake and scores high or low points according to which part is hit. The sound effects and game time follow a similar pattern to those described earlier and the skill level determines how fast the snake moves.

Game 4 - "APOCALYPSE"

This game is the most difficult to play. In essence, the object of this game is to prevent destruction of home territory by preventing the line of lamps 620 associated with the bottom row of the target members 10 in the array of Figure 1, from ever lighting up. The CPU 210 lights lamps 620 down each column of the array at random one after the other in an attempt to illuminate the bottom lamp 620 in any respective column. More than one column is progressing at any one time, so the player is kept active all the time. The object is for the player to extinguish the leading lamp 620 in any column to prevent the bottom lamp 620 from lighting up. Points are scored for each successful "HIT" and appropriate sounds are emitted. If the CPU 210 succeeds in lighting a bottom row lamp 620 associated with the bottom row of target members 10, then several things happen. Firstly, the game program interrupts play and the whole array of lamps 610 of the target members 10 illuminate and begin to flash. After suitable sound effects, an explosive sound is heard from the loudspeaker 350. Points are then deducted from the player's total score at the display 400 (Figure 4CB). Then the game continues. The skill level determines how fast the "missiles" progress down each column.

It is to be appreciated that the embodiment of the invention described above with reference to the accompanying drawings has been given by way of example only and that modifications may be effected. Thus, for example, the physical exercise apparatus may be provided with a speech facility. The physical exercise apparatus may also be provided with printout means for printing out games results or other information relating to the use of the physical exercise apparatus and/or results obtained from the physical exercise apparatus.

The physical exercise apparatus shown in the drawings is of a type for mounting on a wall or other support surface. If desired however the physical exercise apparatus may be in the form of free standing equipment.

It was mentioned above that the control apparatus 40 includes a switching circuit operable to switch in sequence individual target members or groups of target members 10 from the first condition to the second condition in accordance with a game selection, games being stored in a memory associated with a programmable unit in the control apparatus. As an alternative but more usually in addition, the physical exercise apparatus may have input means by which a game from an external memory cartridge can be input into the apparatus. Thus, for example, as shown in Figure 4A, there may be provided a separate plug in device 101 for an external memory games cartridge. As an alternative to using the above mentioned user responsive means to set user selectable durations of play, a separate games cartridge containing three games for example may be plugged into the control apparatus 40. Where a games cartridge is employed, the memory in the cartridge may be updated automatically by a microprocessor if desired. The EPROM memory 240 could be provided in the games cartridge. Instead of storing programmes in the EPROM 240, they may be transferred to the games cartridge. Thus, for example, during operation, the control unit may activate a programme in the EPROM 240 or in the games cartridge, in order to enable the user to make selections at the interactive input 100. In the above described embodiment of "selecting a skill level", the programme initially operated by the EPROM 240 or a games cartridge, may enable the user to make the re-

quired choice. It will thus be apparent that various games progammes can be stored in the EPROM 240 and/or in a games cartridge. Where a games cartridge is employed, this will obviously need to be inserted into the control unit case initially at the start of a game, for example just before or just after the metal token is entered into the type S10 coin mechanism.

It was mentioned above that depending upon the electronic circuitry, the count display may be a running total which changes progressively during the user session or a final total displayed at the end of the session. Alternatively, if desired, two displays may be used for two players, mounted separately on a gantry part of the physical exercise apparatus itself.

Claims

1. Physical exercise apparatus comprising target members to be actuated by a player, switch means associated with the target members such that activation of the target members causes a change in the status of the switch means, signal means selectively responsive to the status of said switch means, and control means for selectively causing said signal means to change between a first condition and a second condition.

2. Apparatus according to claim 1 comprising a plurality of the target members for arrangement at discrete spaced locations in an array for use in physical exercise by a user equiped with a playing member; each target member being actuable in response to contact therewith by a playing member; the signal means being associated with each target member for indicating the first and second condition; the control means being for selectively causing said signal means to be switchable from said first condition to said second condition; the switch means being associated with each target member and responsive to said contact by the playing member with the target member to change status, said change of switch means status permitting said signal means to change from one to the other of said first and second conditions; and the control means being operable to cause said signal means to change condition in a sequence to be followed by the user.

3. Apparatus as claimed in claim 1 or claim 2 wherein the array is determined by supports for the target members, wherein the supports are arranged in a plurality of spaced upright columns with a series of the target members being located in each column with a spacing therebetween, wherein the target members each comprise a housing accommodating its signal means and arranged to actuate its switch means, and wherein said switch means is responsive to displacement of the housing of the target member on impact thereof by a user equipped with a playing member thereby to return said signal means to said first condition.

4. Apparatus as claimed in any one of the preceding claims wherein the signal means is a lamp means which is illuminated in said second condition, and wherein the signal means emits an audible signal when in said second condition.

5. Apparatus as claimed in any one of the preceding claims wherein the control apparatus includes a switching circuit coupled to the signal means of each target member and operable to switch in sequence individual target members or groups of said target members from said first condition to said second condition in accordance with a game selection.

6. Apparatus as claimed in claim 5 wherein the control apparatus includes means for generating a random sequence for the selective switching of the signal means.

7. Apparatus as claimed in any one of the preceding claims wherein the control apparatus includes user responsive means for setting variable parameters for the user of the physical exercise apparatus, said parameters including at least one of user selectable switching intervals and user selectable durations of play.

8. Apparatus as claimed in any one of the preceding claims wherein the control apparatus includes timing means determining the duration of a user session on the apparatus.

9. Apparatus as claimed in any one of the preceding claims wherein the control apparatus includes counting means for recording the number of user initiated changes in the instant condition of the switch means.

10. Apparatus as claimed in any one of the preceding claims wherein said control means has a programmable unit, memory means for storing programmes which predetermine an exercise routine to be followed by a player when actuating the target members, and input means by which a game from an external memory cartridge can be input into the apparatus.

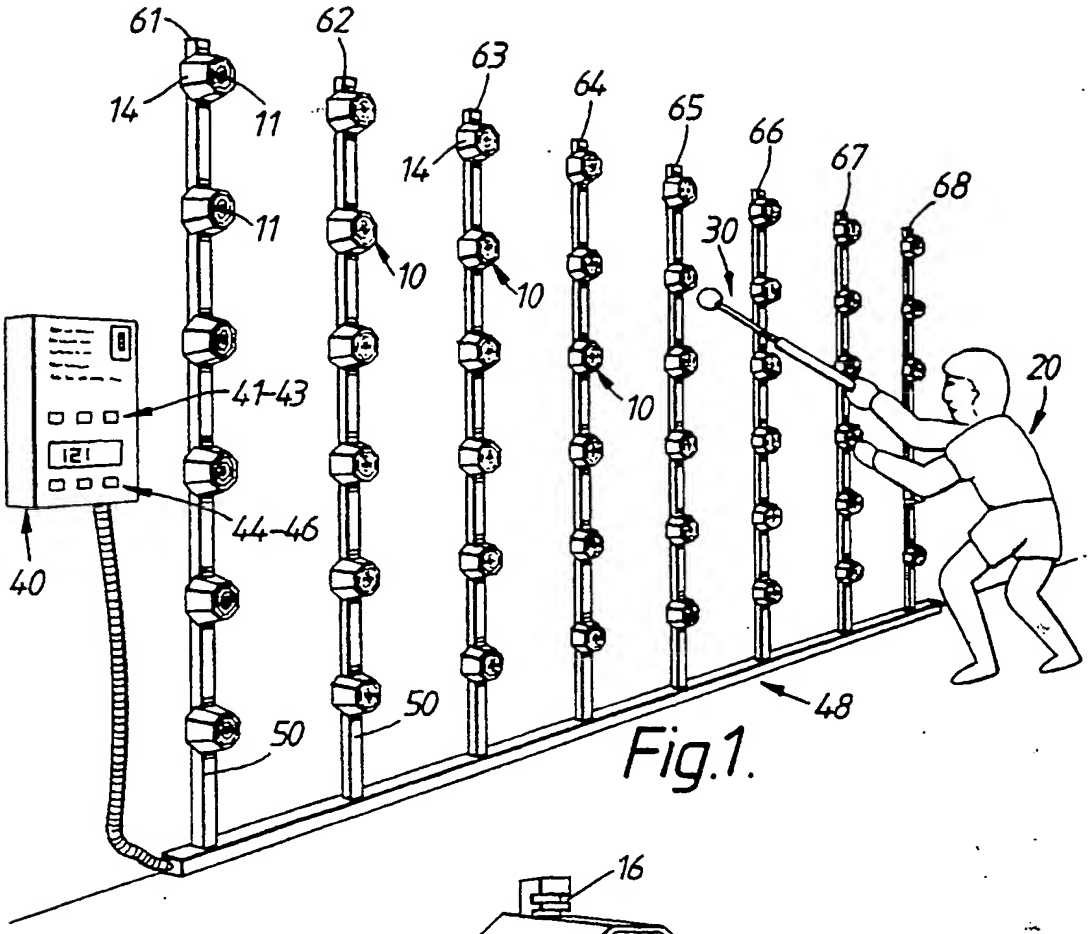


Fig.1.

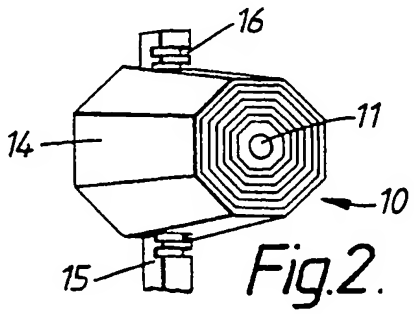


Fig.2.

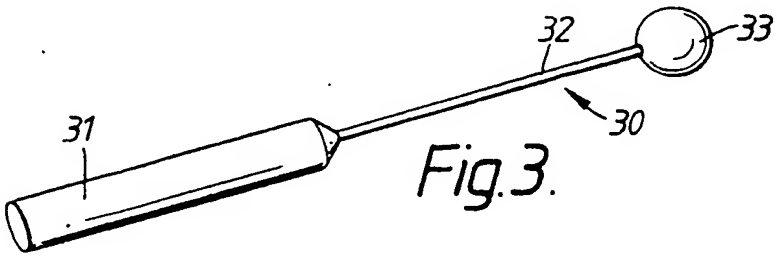


Fig.3.

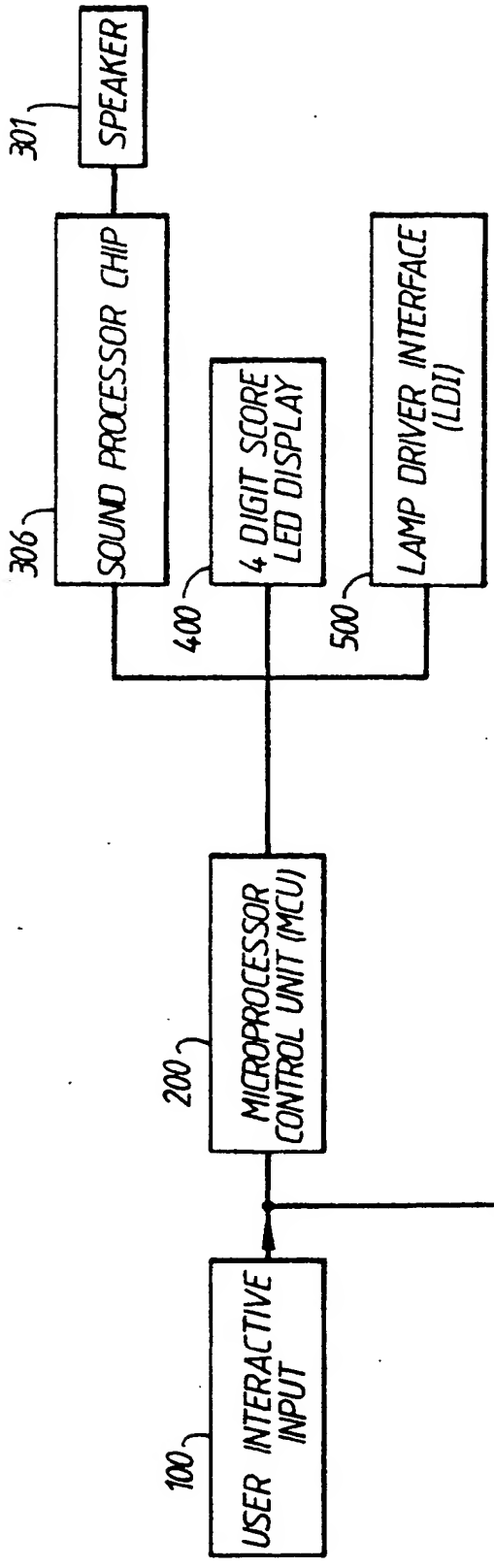
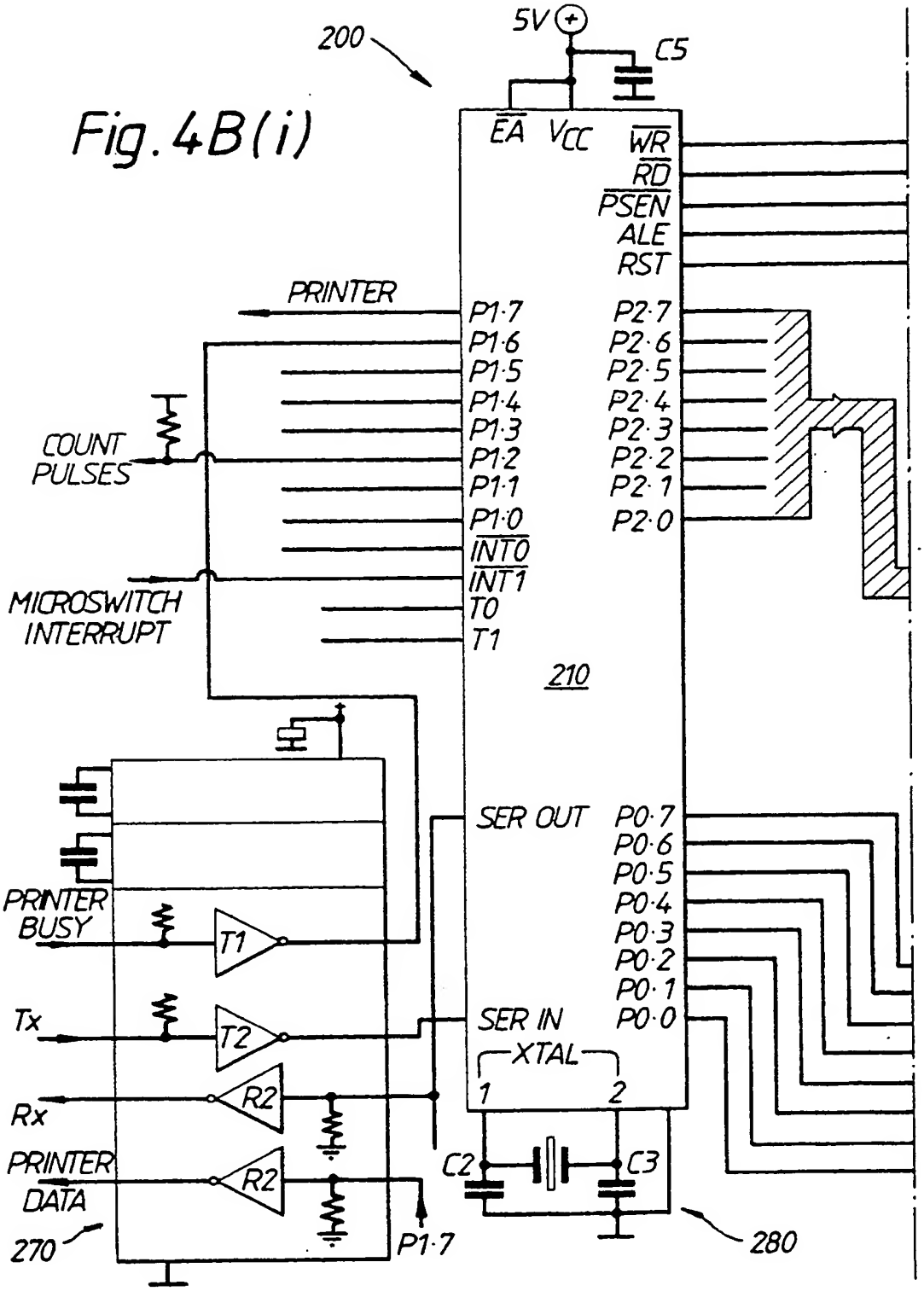


Fig. 4A.

Fig. 4B(i)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EA
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RD
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ALE
RST
PRINTER
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P1·6
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P1·3
P1·2
P1·1
P1·0
INT0
INT1
T0
T1
P2·7
P2·6
P2·5
P2·4
P2·3
P2·2
P2·1
P2·0
COUNT PULSES
MICROSWITCH INTERRUPT
210
SER OUT
SER IN
XTAL
1
2
P0·7
P0·6
P0·5
P0·4
P0·3
P0·2
P0·1
P0·0
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T2
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R2
PRINTER DATA
R2
C2
C3
270
P1·7
280

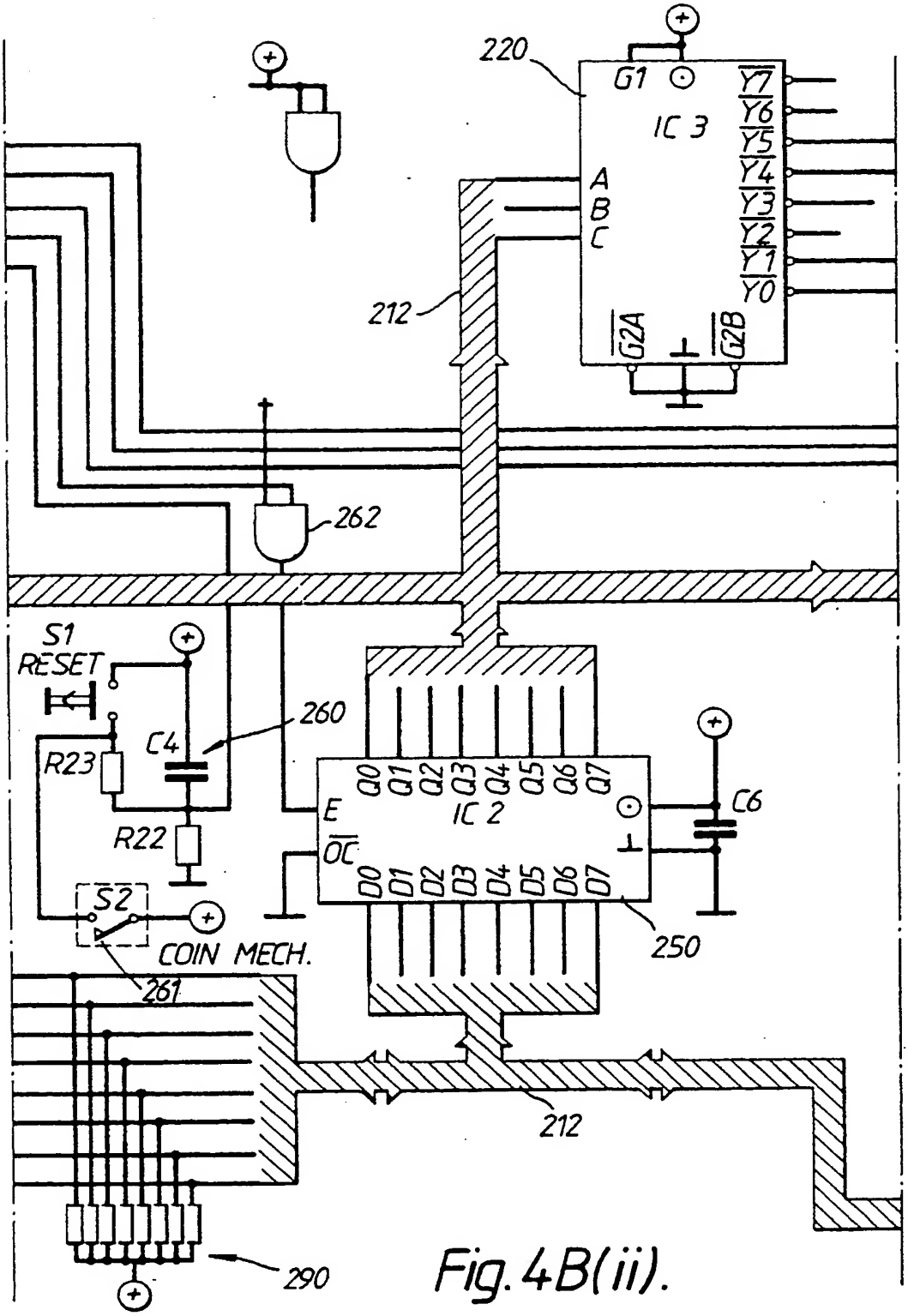


Fig. 4B(ii).

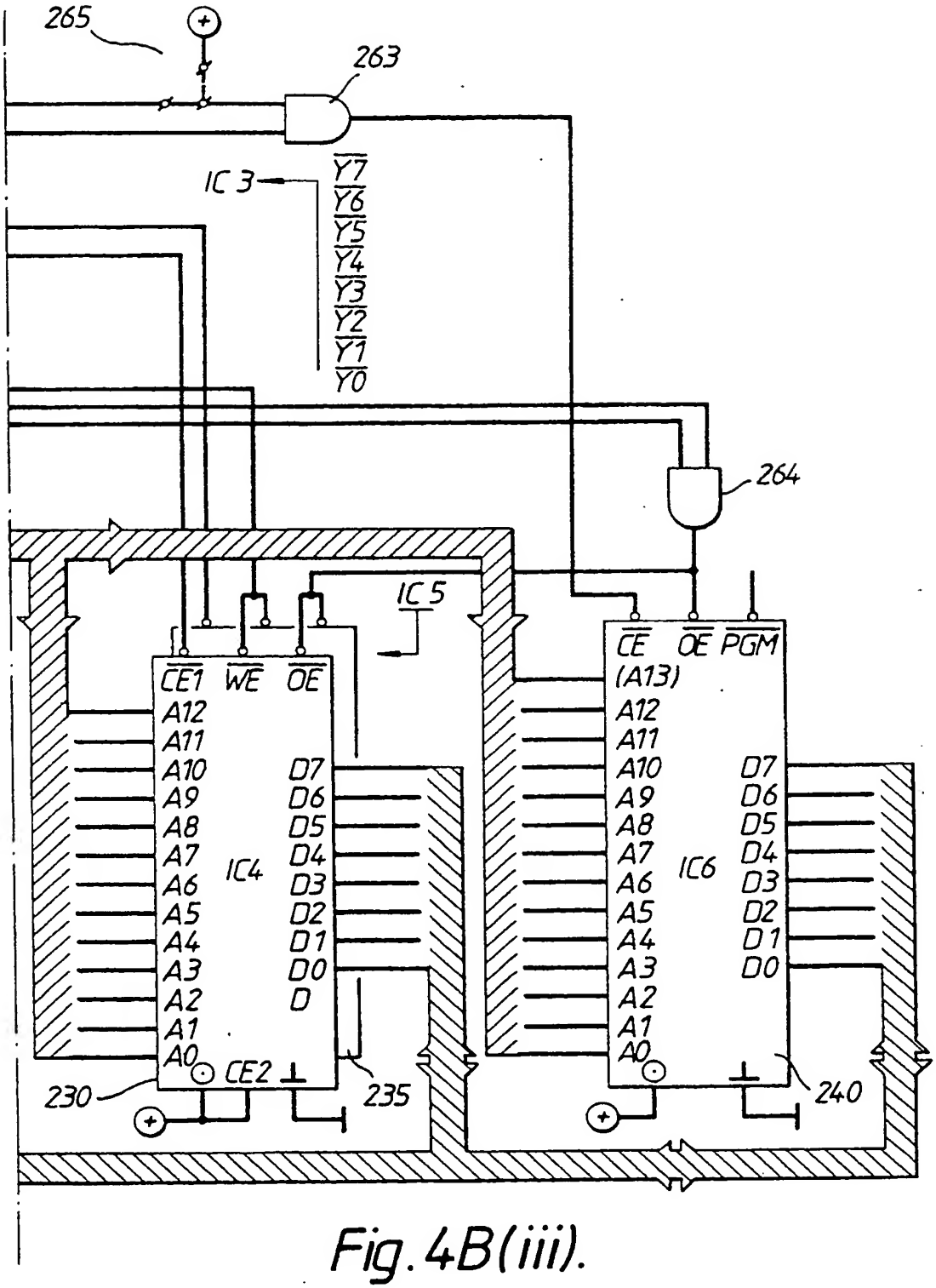


Fig. 4B(iii).

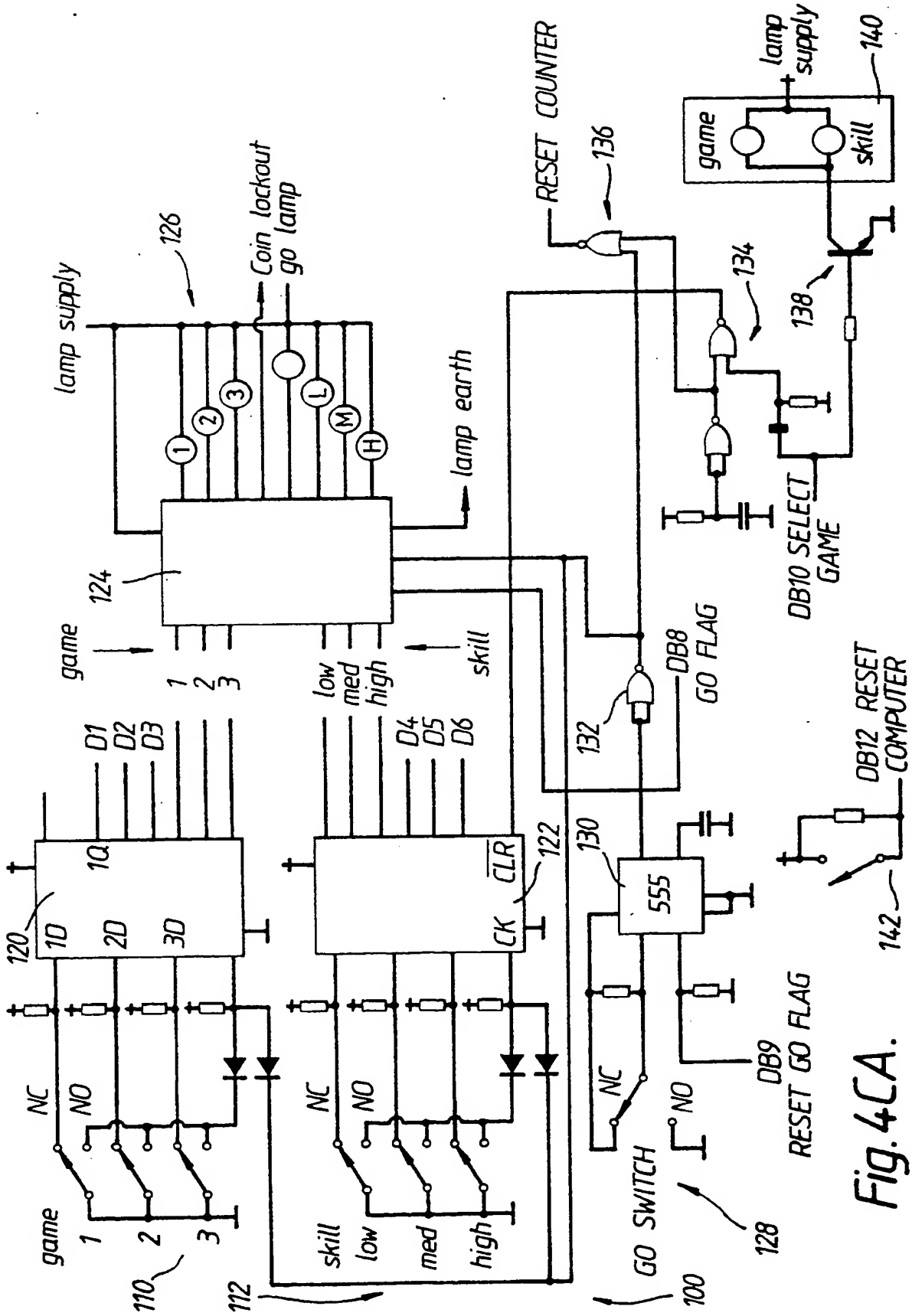


Fig.4CA.

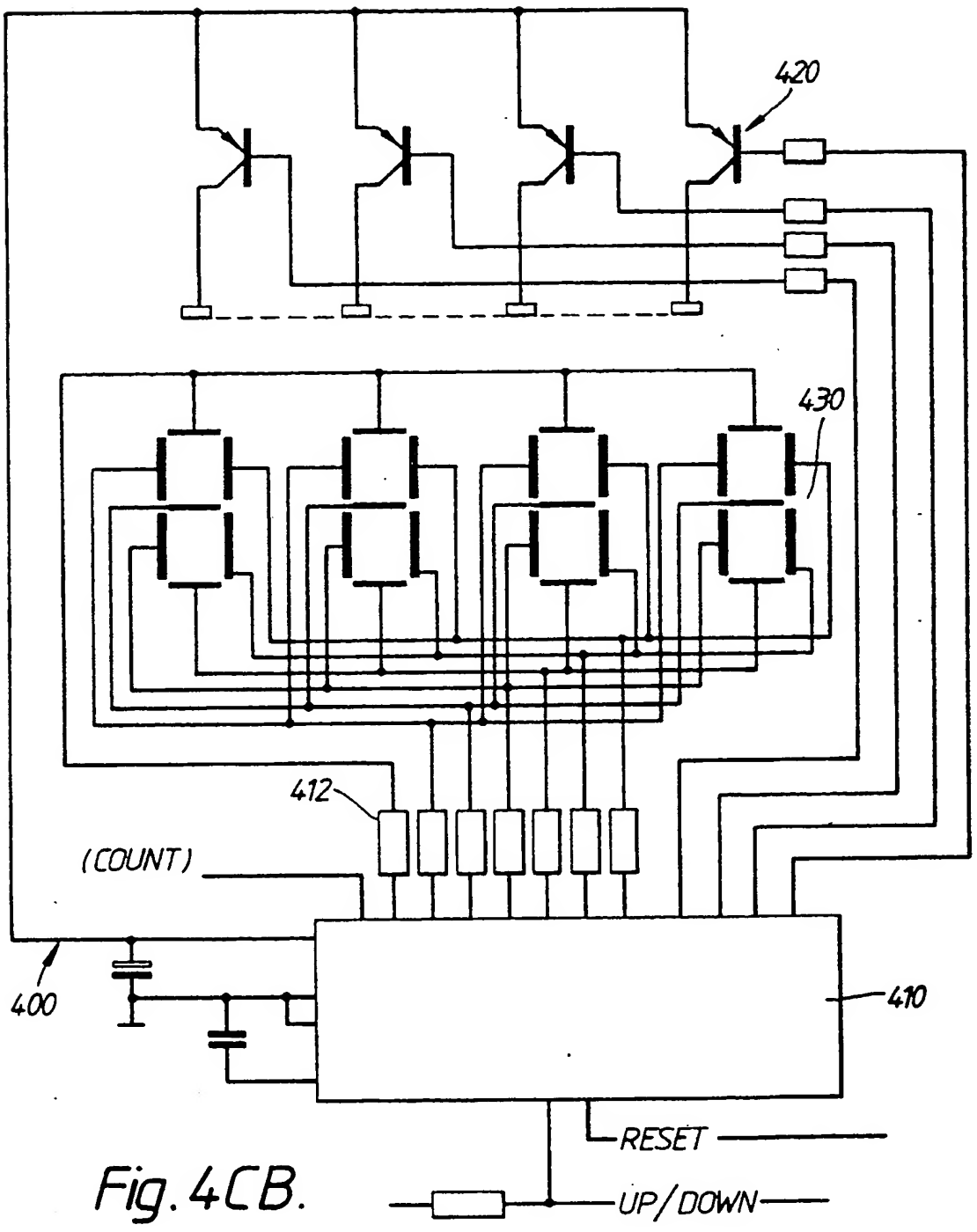


Fig. 4CB.

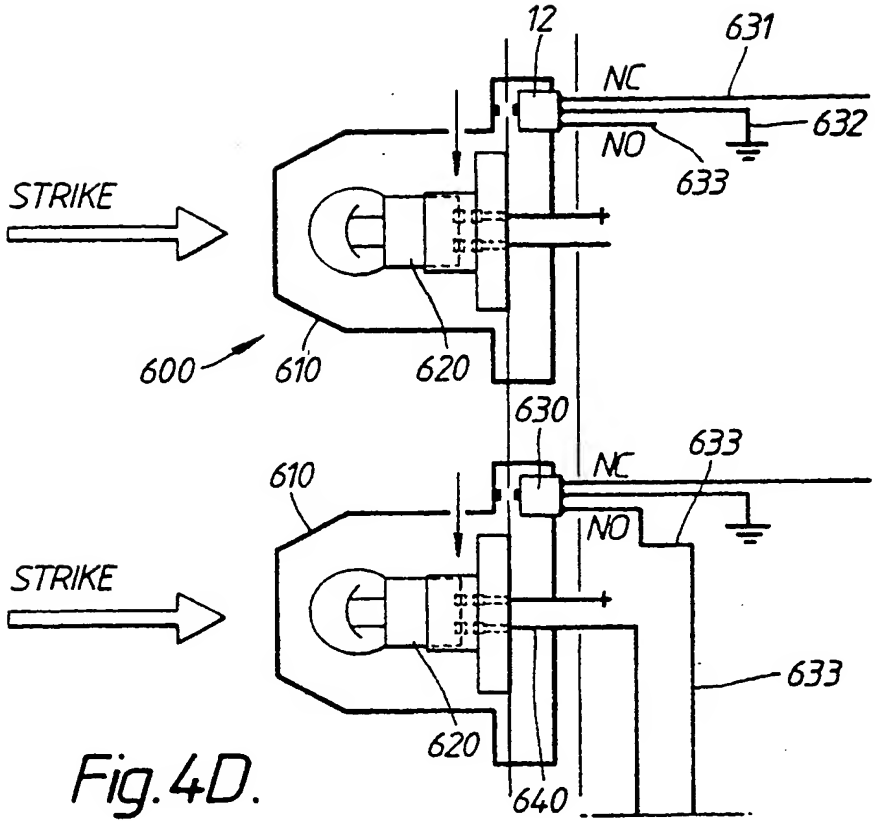


Fig.4D.

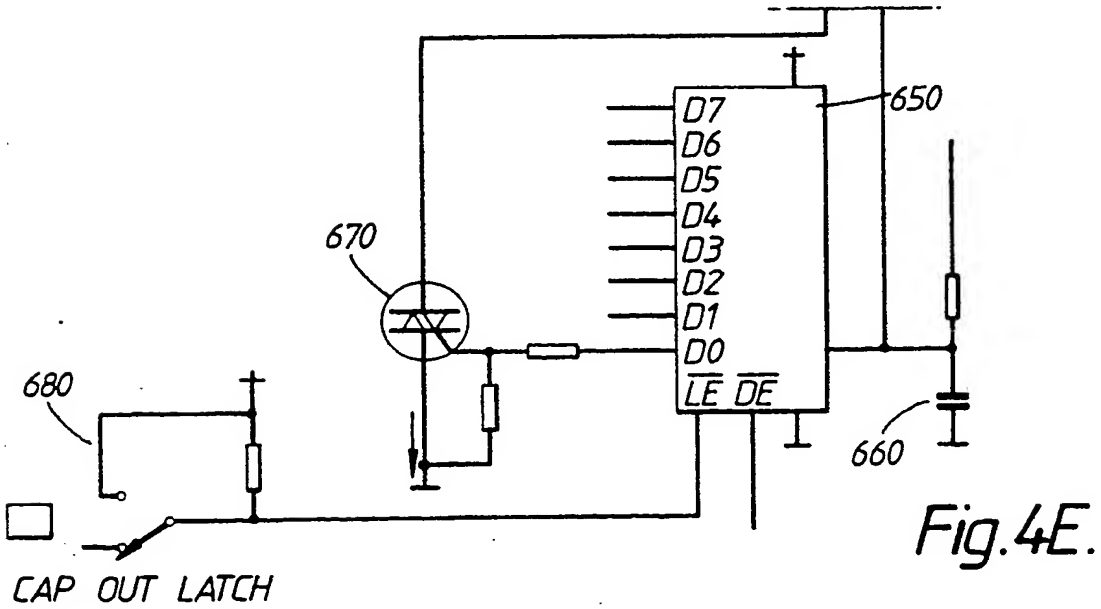
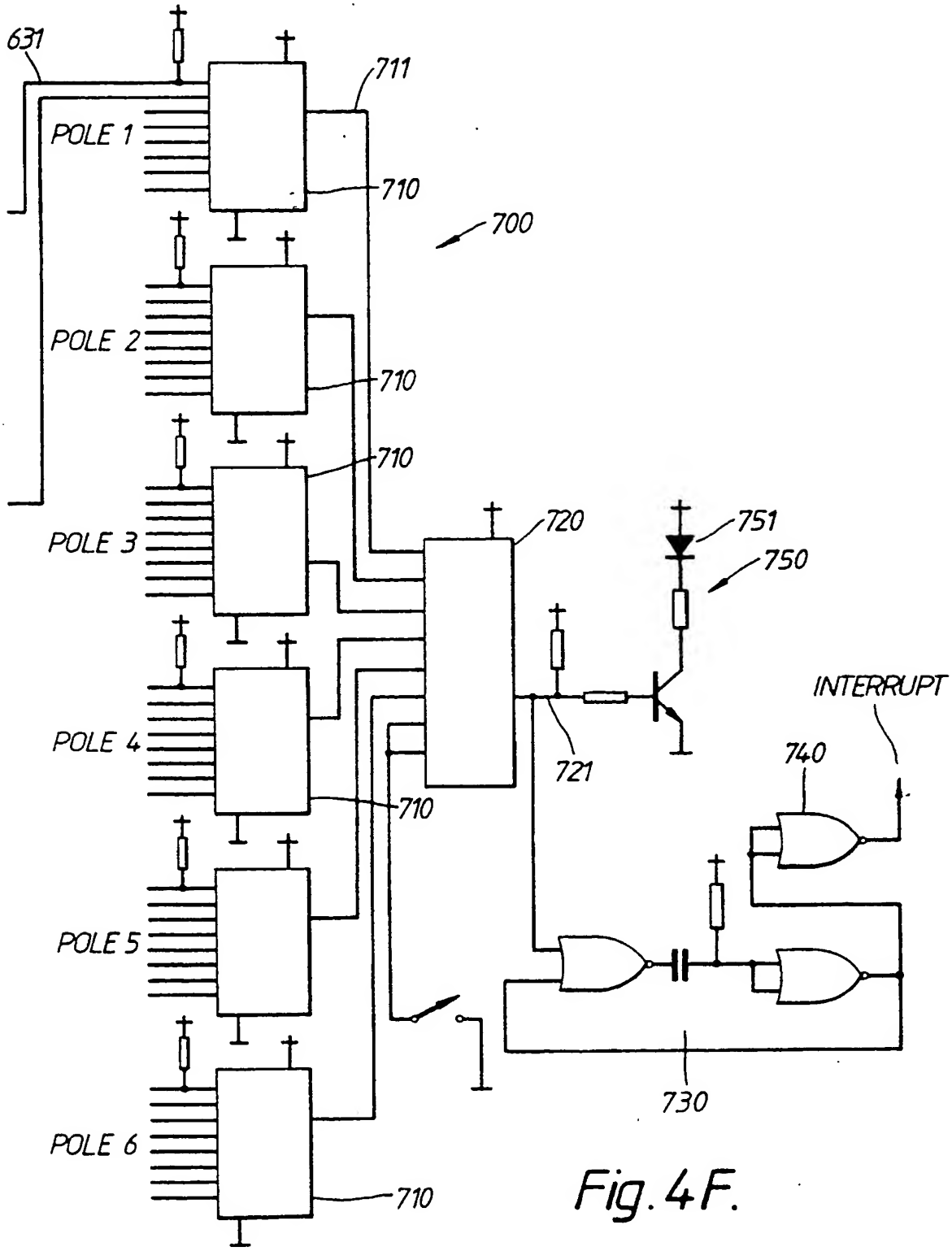


Fig.4E.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700
POLE 2
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710
POLE 3
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751
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INTERRUPT
POLE 4
721
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710
POLE 5
730
POLE 6
710

Fig. 4F.

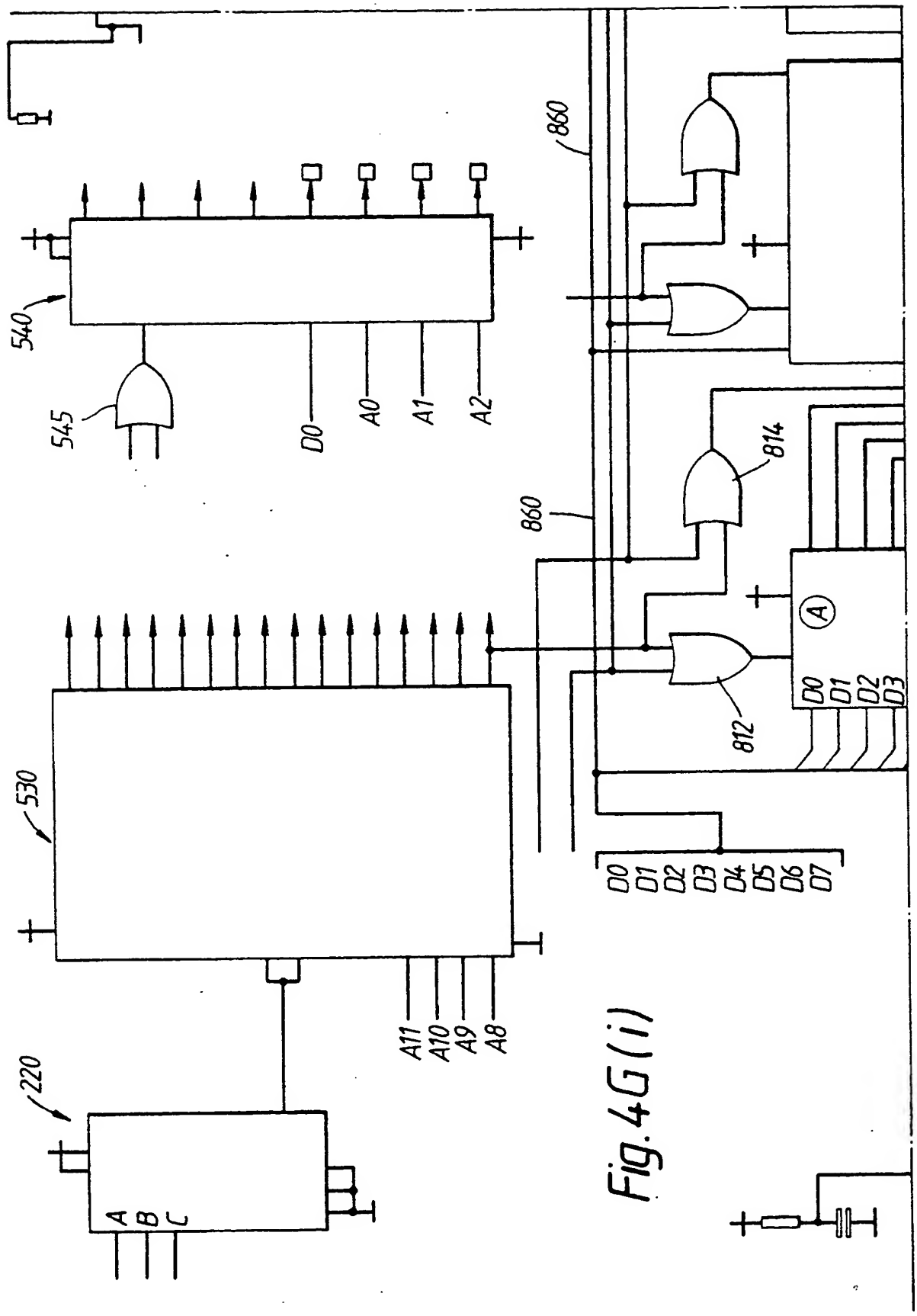

Fig. 4G (i)

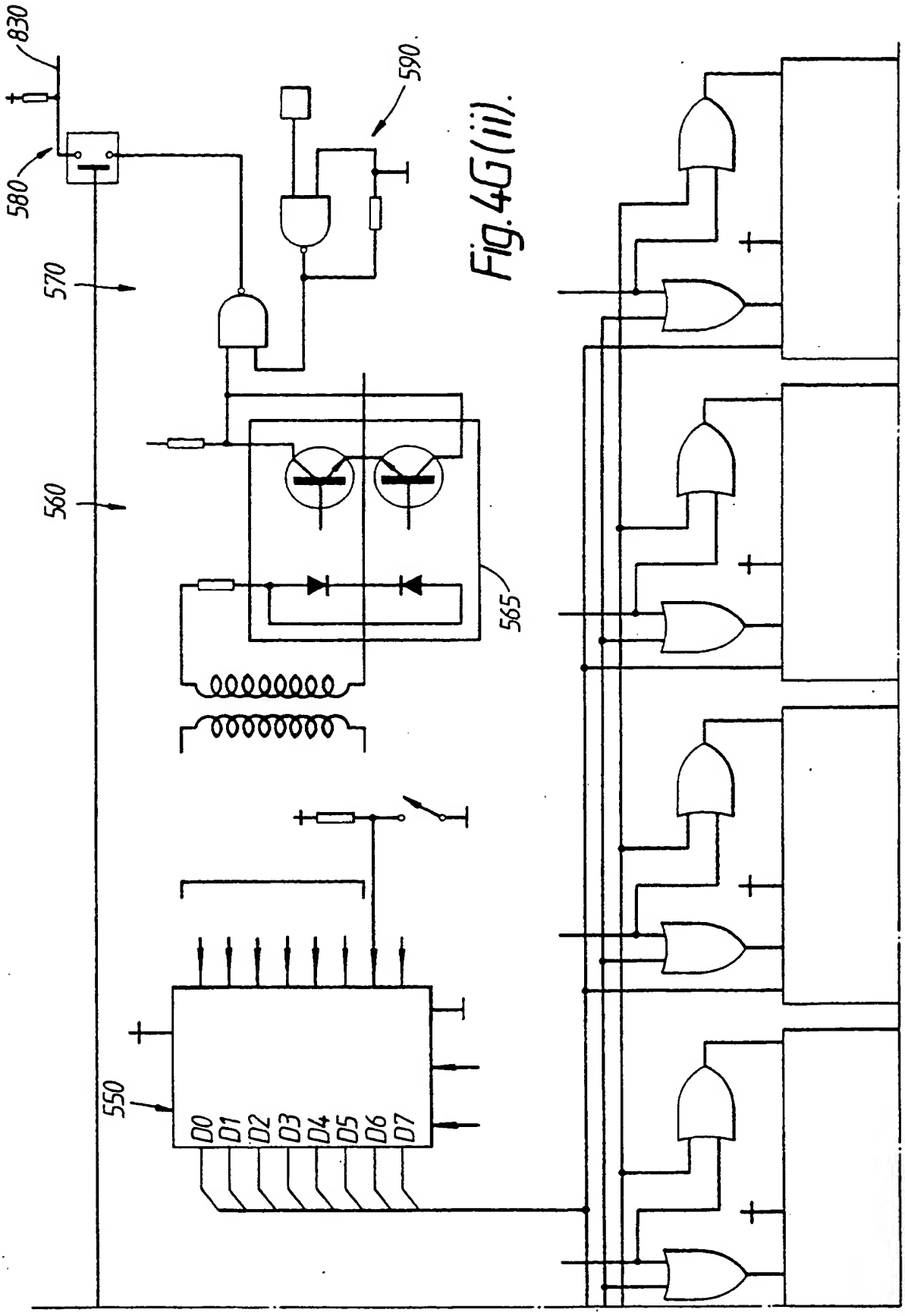

Fig. 4G(iii).

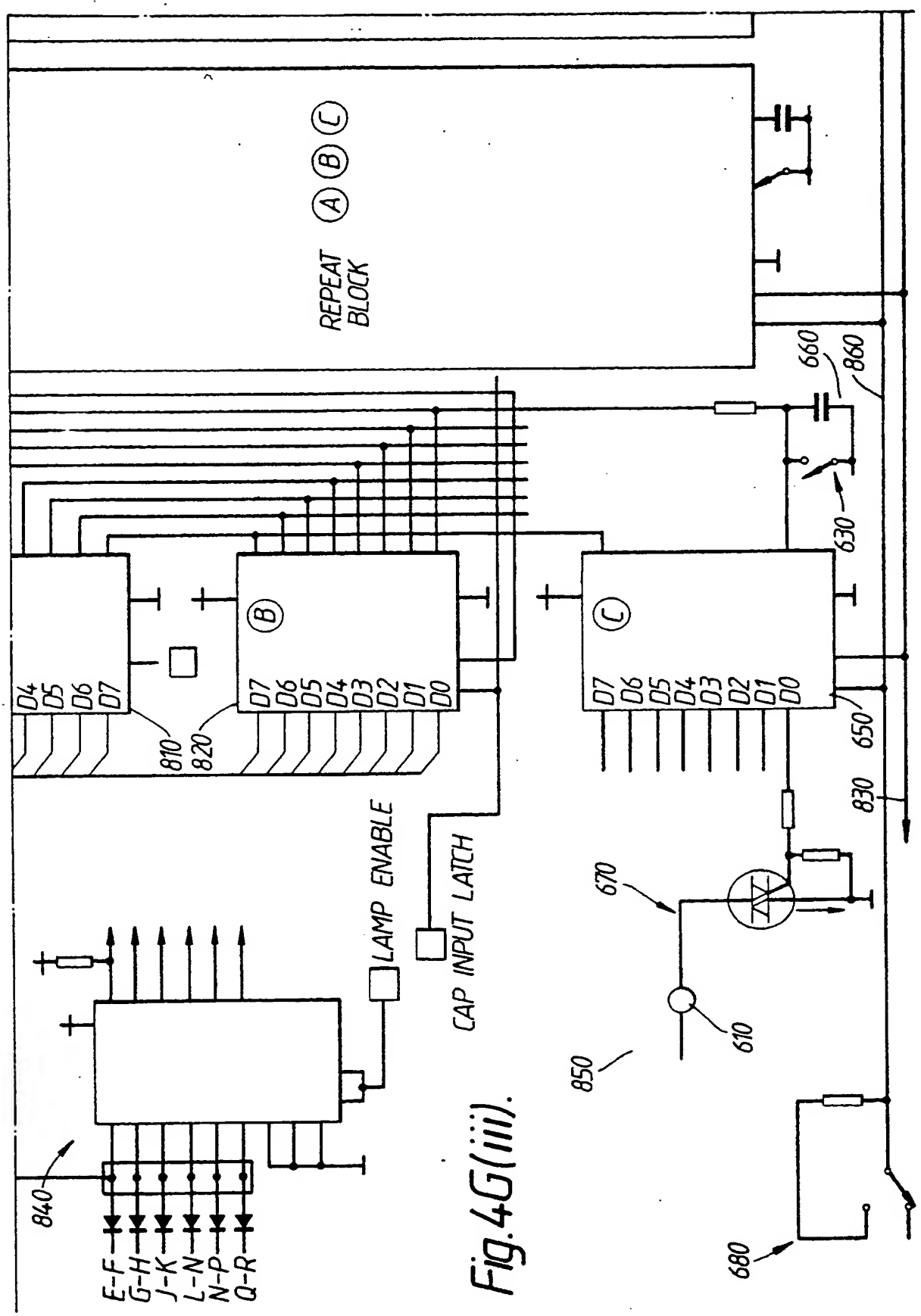

Fig.4G(iii).

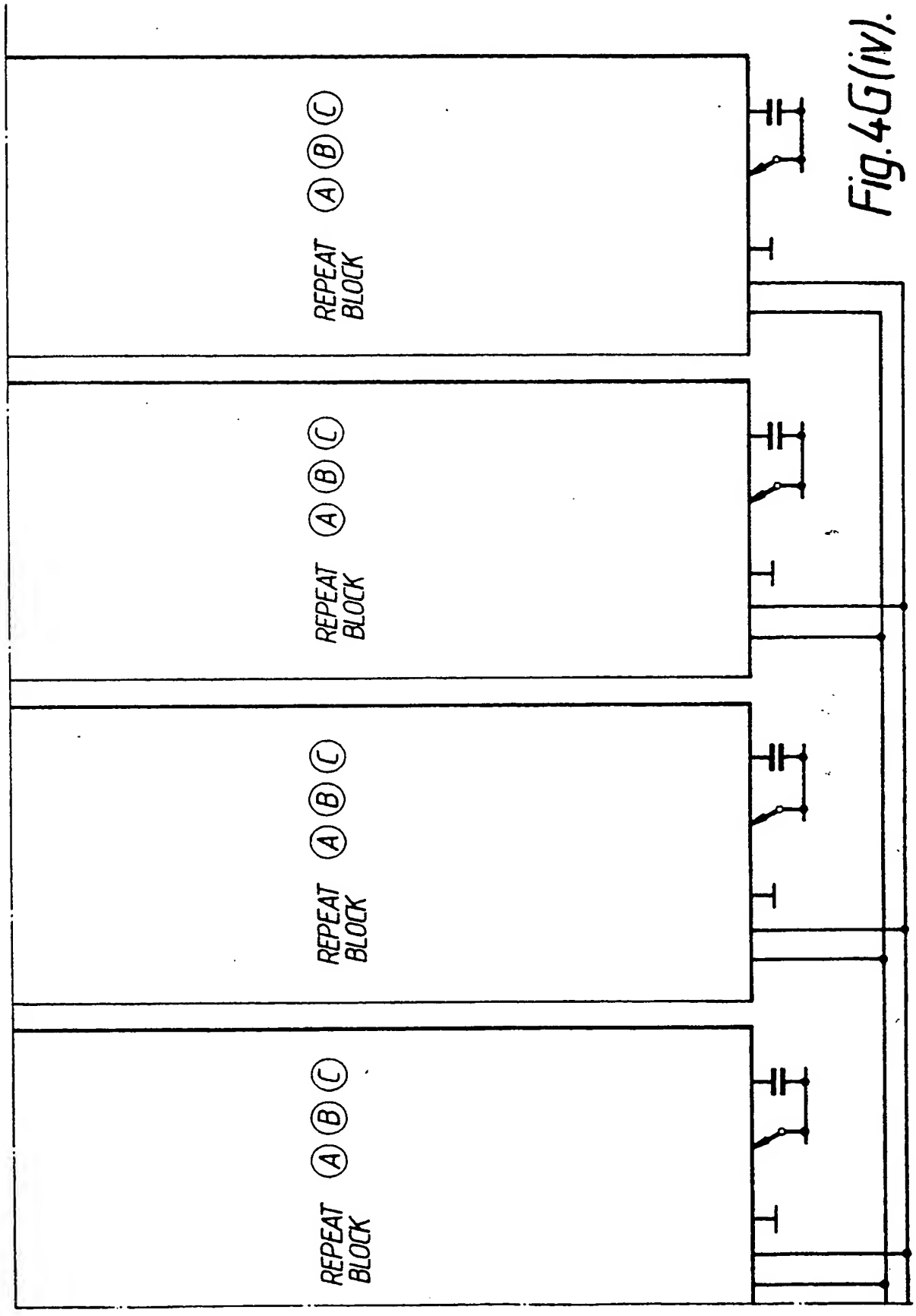

Fig.4G(iv).

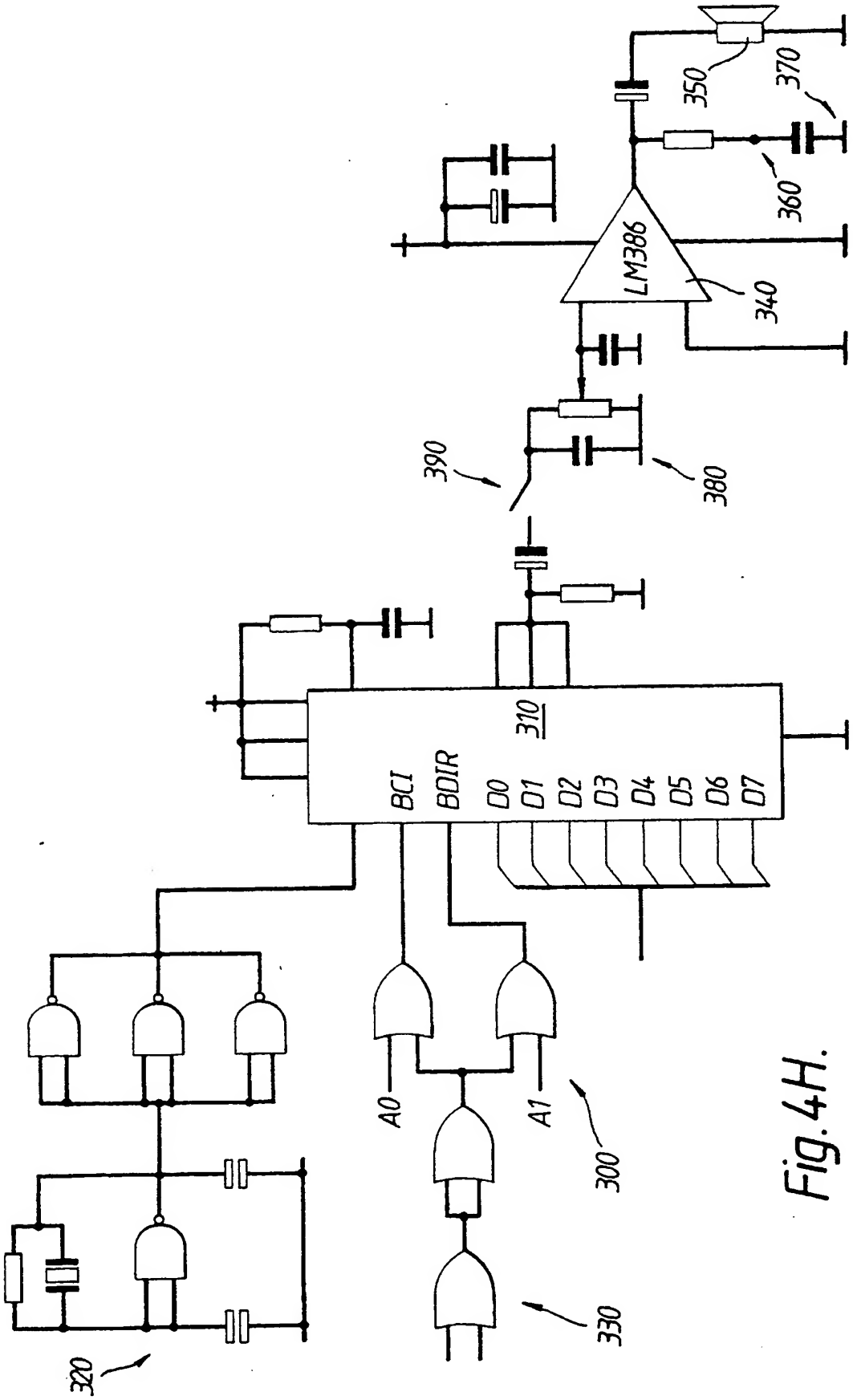

Fig. 4H.

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 90306029.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 5)
A	SOVIET INVENTIONS ILLUSTRATED, P,Q sections, week 8609, April 9, 1986 DERWENT PUBLICATIONS LTD., London, page 8 * SU-1172-573-A (ALMA) * --	1,2,4	A 63 B 69/00 A 63 B 21/00
A	DE - A1 - 3 204 042 (GLASS) * Abstract; claims 1-8; fig. * ----	1,4,5, 8,9,10	

TECHNICAL FIELDS SEARCHED (Int Cl 5)

A 63 B 69/00
A 63 B 21/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	22-08-1990	SCHÖNWÄLDER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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